(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : 0 685 662 A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number : 95610029.1

(51) Int. Cl.[6] : F16H 25/20

(22) Date of filing : 31.05.95

(30) Priority : 31.05.94 DK 614/94

(43) Date of publication of application :
06.12.95 Bulletin 95/49

(84) Designated Contracting States :
BE CH DE DK ES FR GB IT LI NL SE

(71) Applicant : LINAK A/S
Smedevaenget 8,
Guderup
DK-6430 Nordborg (DK)

(72) Inventor : Jensen, Bent
Smedevänget 8
Guderup, DK-6430 Nordborg (DK)

(74) Representative : Pedersen, Soeren Skovgaard
c/o K. Skoett-Jensen Patentingenioerer A/S,
Lemmingvej 225
DK-8361 Hasselager (DK)

(54) A linear actuator.

(57) A linear actuator comprises a threaded spindle (4) rotatable in either direction, a threaded bushing (9) that drives an output rod (11) and a reversible motor (12) that drives the spindle via a power transmission (13). In certain cases such as hospital beds it might be desired instantly to arrive at one or the other extreme position or an intermediate position from a random position. This is achieved by a power transmission which by a coil spring can be disconnected from the spindle which is not of the self locking type. The disconnection is caused by the ends of the coil spring being enveloped by and embedded in two cylindrical caps (7,10) that can slide inside one another and are connected such that they by a compression perform a mutual rotation whereby the coil spring can be released.

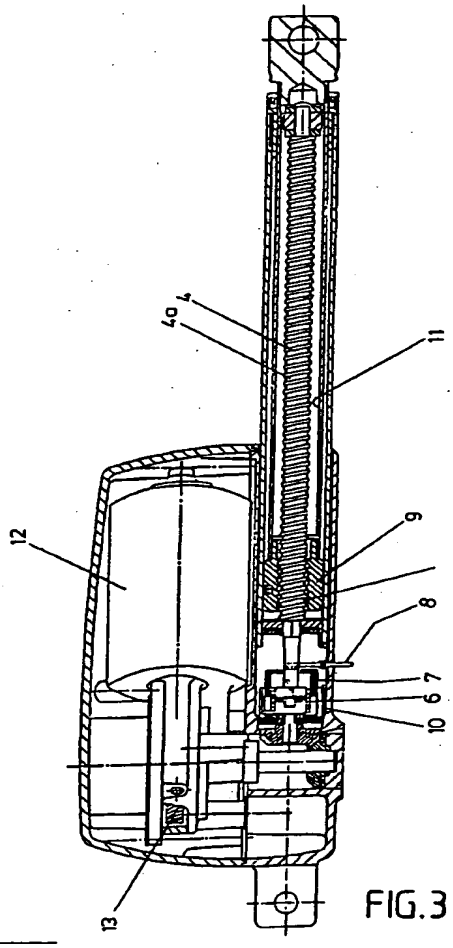

FIG.3

EP 0 685 662 A2

The invention relates to a linear actuator comprising a threaded spindle rotatable in either direction, a threaded bushing that is not self-locking on the spindle and that drives an output rod and a reversible motor that drives the spindle via a power transmission, said power transmission being releasable from engagement with the threaded spindle.

Linear actuators of the type mentioned above are used for a multitude of operations where a linear movement or power actuation is desired. They are often used where a hydraulic or pneumatic installation would be totally unsuitable and where an electric driving power is to be preferred. Electrically operated doors and hospital beds may be mentioned as examples where the linear actuator is positioned such that the output rod performs the required movement from one position to another as a result of a power supply of one or the other polarity and possibly guided by limit stops.

In practical use a desire to arrive from one extreme position to the other at great speed may arise, or to arrive from a given position to one of the extreme positions or in general to be able to effect an adjustment of the moved unit without being bound to the mechanism of the linear actuator. Doors may be required to close rapidly like fire doors due to the release of safety devices caused by excessive temperatures or a normally closed door must serve as an emergency exit even in the case of a power supply failure. In a hospital bed it might be desirable to achieve a totally horizontal position quickly despite the head of the bed having been raised. In those cases where a power supply is based on batteries, the power transmission will have a high ratio, and it will consequently be relatively slow. The same will apply for linear actuators that must perform a heavy pulling or pushing force by means of the output rod.

Prior art solutions to this return problem have generally been based on toggle link mechanisms that may be released or on locking pins that may be pulled out such that the output rod no longer acts as a bar against movement. These prior art solutions suffer from the severe drawback that the linear actuator may not be brought back to its normal function again until the moved unit has been returned to its pre-released position upon which the releasing mechanism can be reset, for instance by inserting the pulled-out locking pin. Furthermore mechanisms of the type mentioned suffer from the drawback of not allowing passage from one position of the shifted element to another without interaction with the linear actuator and its subsequent random engagement.

The object of the invention is to provide a solution to the problem described eliminating the drawbacks that are incurred when applying the prior art solutions. This is achieved by a linear actuator according to the invention which is characteristic in having a threaded bushing that is not self-locking on the spindle and that the power transmission can be released from engagement with the spindle.

In an embodiment of the invention use is made of a trailing release unit which ideally should be inserted between the spindle and the spindle drive shaft.

The coupling comprises two independent and successively arranged axially oriented cylindrical coupling members that are fixedly attached to the spindle and the spindle drive shaft respectively, said cylindrical parts being enveloped by a coil spring.

The two radially oriented activating pins of the coil spring, preferably an angled endportion thereof, are each in engagement with two enveloping and mutually rotatable activating members which follow the rotation of the coil spring.

The coil spring will in its unloaded postion, by its own initial load and by a rotation impact in one direction, lock itself about the two coupling members and consequently allow a power transmission from one coupling member to the other whereby the motor can pull the spindle.

The disengagement is caused by the coil spring being mechanically "opened" by a cross axially oppositely directed impact on one or both of the two protruding activating pins as these pins each are individually controlled by activating members which being in engagement with one another envelopes the coil spring. The members will by a further compression which is caused by a manually operated lever, by mutually cooperating guiding members, perform a rotation about the shaft relative one another whereby the activating pins of the spring are cross axially displaced and oppositely relative one another. The inner diameter of the coil spring is hereby increased such that its grip round the cylindrical coupling members stops or at least adopts such low friction that the spindle, under an increased pressure from its threaded spindle, can rotate whereby the exposed lever can take up the desired position.

Cooperating with the exposure of the actuator lever, the rotational direction of the drive shaft will tighten the coil spring and hereby transmit the power from the motor. By rotation in the opposite direction the coil spring is "opened" whereby the friction between the coupling members and the coil spring be significantly reduced. The coupling members can hereby rotate comparatively freely. This means that the actuator can be pulled out manually until it reaches its mechanically defined outer limit.

The invention shall be described in further detail referring to the drawing in which:-

Fig. 1 is a lateral view of a complete disengagement unit, and

Fig. 2 is an exploded drawing of a coil spring activating mechanism according to the invention,

Fig. 3 illustrates a longitudinal section through an actuator by means of which the invention may be carried into effect, and

Fig. 4 illustrates a longitudinal section through an actuator with a worm by means of which the invention may be carried into effect.

Fig. 1 shows two cylindrical couplings 1 and 2. The cylindrical coupling portion 1 is directly attached to a drive shaft 3, and the coupling portion 2 is fixedly attached to a spindle 4. Between the coupling portions 1 and 2 and behind the coupling portion 1 ball bearings 5 have been inserted to reduce the friction between the coupling portions 1 and 2 and a rear wall 3a for absorbing the pressure being caused in the direction B. The pressure in the direction B, which is caused by an ordinary weight effect to the actuator, is transferred through a threaded bushing 9 and balls 9a that are in engagement with a thread 4a on the spindle 4.

The coupling portions 1 and 2 are enveloped by a coil spring 6 which at each end terminates in upwardly protruding endportions acting as activating pins 6a and 6b. The activating pin 6a is guided by a guiding groove 7b in an enveloping cup-shaped unit 7 being inserted into a larger cup-shaped unit 10 in which a recess 10b has been made to accommodate the activating pin 6b of the coil spring 6.

When using the free edge as a starting point, the unit 7 is provided with two opposed guiding grooves 7a of which one is shown in Fig. 1 and where the other appears in Fig. 2. Corresponding pins 10a are placed inside the unit at the front edge of the cup-shaped unit 10 engaging the guiding grooves 7a on the unit 7. The first portion of the guiding grooves 7a is axially oriented but will swing in the same direction towards a radial orientation further away from the edge.

Releasing the coupling takes place by shifting an activating lever 8 which can be pivoted about a shaft 8a by an impact in the direction A. The activating lever 8 presses at the point 8b to the cap 7 which hereby is moved in the direction B. By this compression the two caps 7 and 10 are rotated about the longitudinal axis relative one another. The activating pin 6a of the coil spring guided by the recess 7b will hereby be rotated in the direction C relative the other activating pin 6b of the coil spring whereby the coil spring "opens". The coupling member 2 can now rotate freely in the coil spring 6 as a result of the previously mentioned impact in the direction B.

In Fig. 3 of the drawing the invention is shown implemented at an actuator where the spindle is driven via two oblique gear wheels, and in Fig. 4 the invention is shown implemented at an actuator where the spindle is driven via a worm.

Claims

1. A linear actuator comprising a threaded spindle (4) rotatable in either direction, a threaded bushing (9) that drives an output rod (11) and a reversible motor (12) that drives the spindle via a power transmission (13), said power transmission (13) being releasable from engagement with the spindle, characterized by a disengagement unit between the spindle (4) and the spindle drive shaft (3) said unit comprising two independent and successively arranged axially oriented cylindrical coupling members (1,2) that are fixedly attached to the spindle (4) and the spindle drive shaft (3) respectively, said cylindrical parts being enveloped by a coil spring (6), the two radially oriented activating pins (6a,6b) of the latter, each being in engagement with two enveloping and mutually rotatable cylindrical caps (7,10) which under normal operating conditions follow the rotation of the coil spring and where disengagement is performed by the mechanical "opening" by a cross axially and oppositely directed impact on one or both of the protruding activating pins of the spring, these two being turned away from one another by a mutual turning of the activating caps (7, 10).

2. A linear actuator according to claim 1, characterized in that the cylindrical activating cap (10) has pins (10a) cooperating with a track (7a) terminating in a curve in the other cylindrical cap (7) such that these are turned away from one another at compression.

3. A linear actuator according to claims 1 or 2, characterized in that the compression is performed by a Y-shaped activating lever (8) operating on one activating cap (7A), preferably the end of said cap.

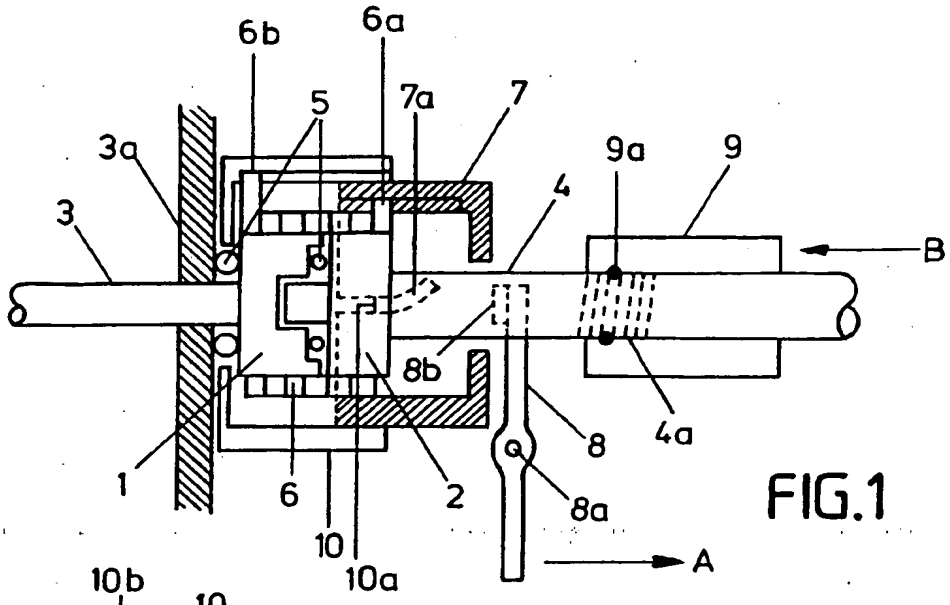
6b
6a
5
7a
7
3a
9a
9
3
4
B
8b
8
4a
1
6
2
8a
10
10a
A

FIG.1

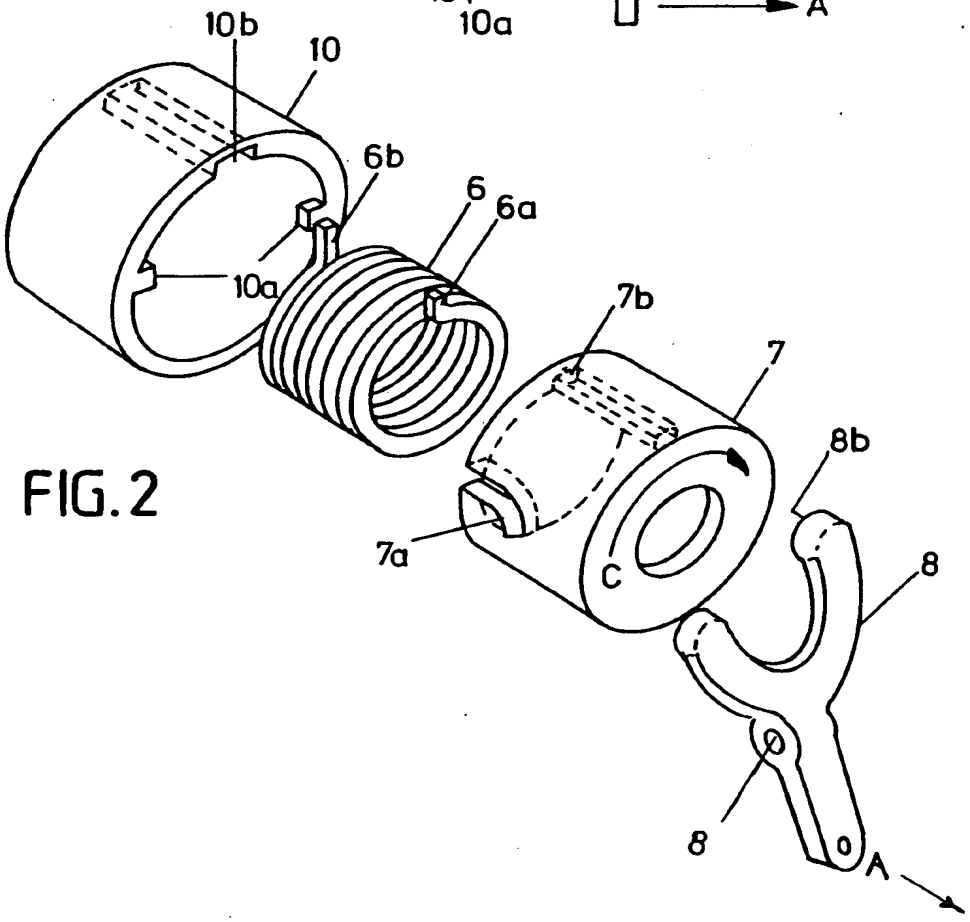
10b
10
6b
6
6a
10a
7b
7
8b
7a
C
8
8
A

FIG.2

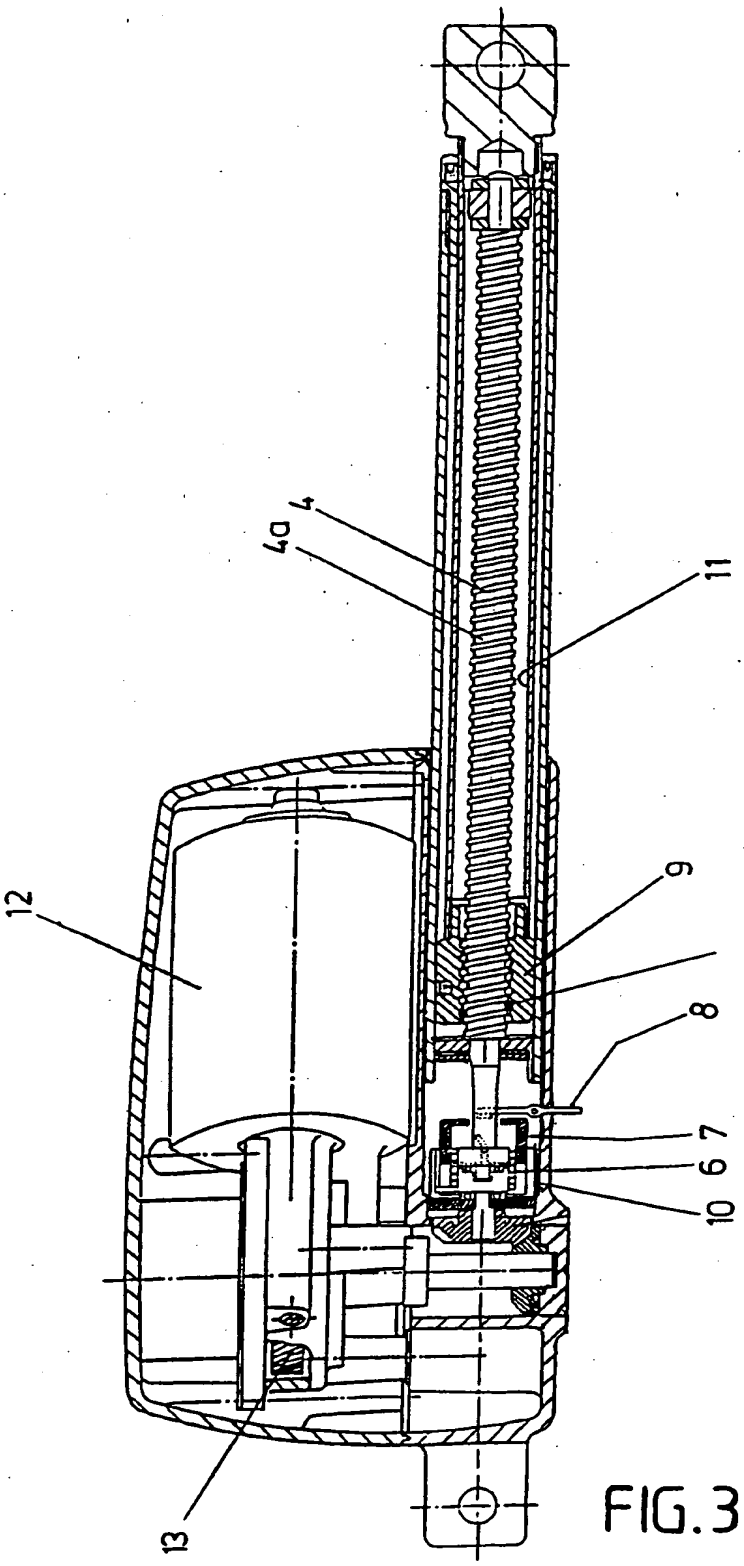

FIG.3

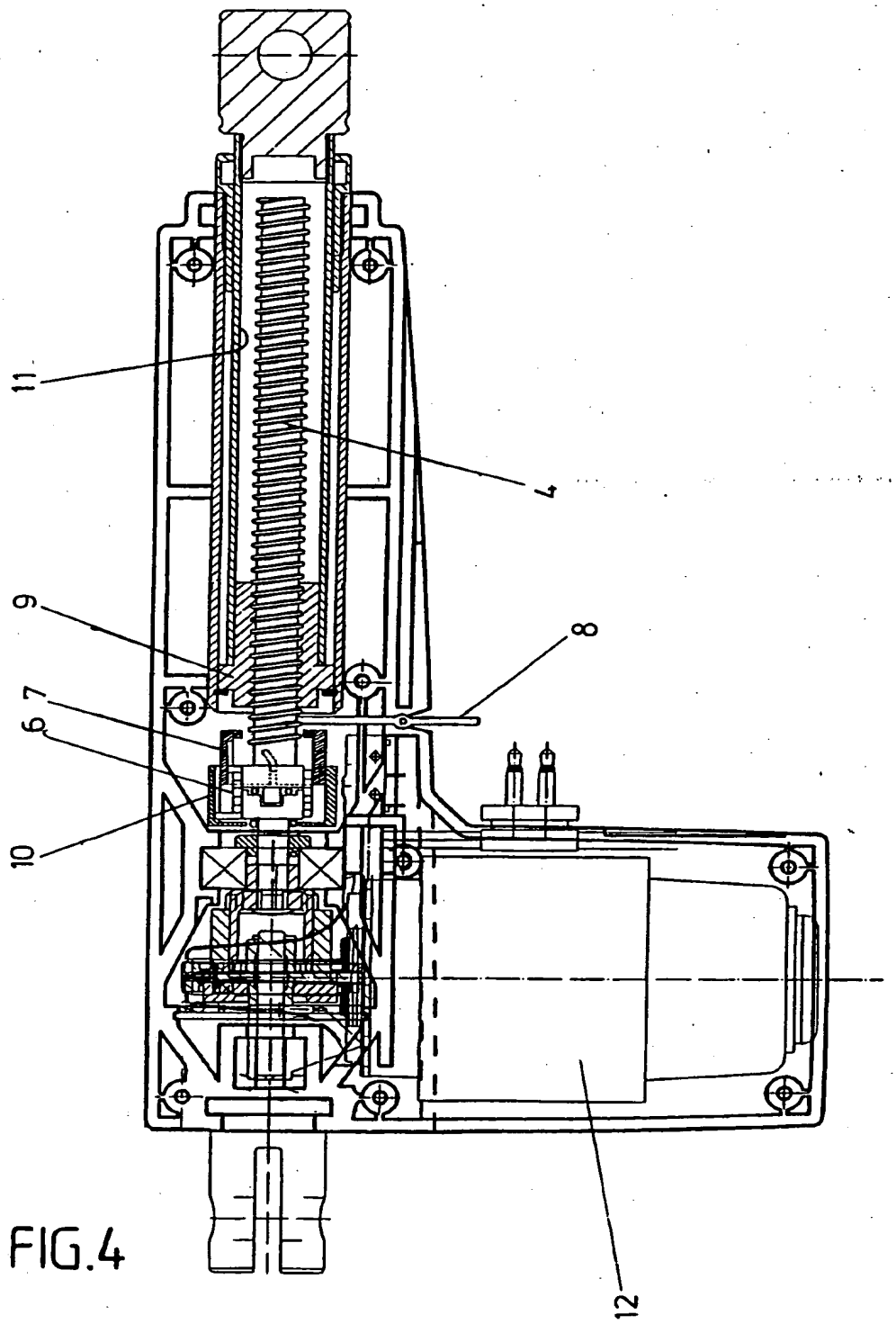

FIG.4